

Remarks/Arguments

Applicants thank Examiner Sandvik again for his patient and careful examination of this application and the clear explanation of the claim rejections. In response to the Final Office Action of December 15, 2006, applicants respectfully submit that because the motivation to combine references is not supported by evidence, a prima facie case of obviousness against independent claim 5 is not established. And the 103 rejection against claim is therefore improper.

The new reference cited against claim 5 in the Final Office Action is a patent publication by Joshi et al.¹ The Joshi reference teaches providing a copper stud on the contact pads of a device. According to the Final Office Action, this cures the deficiencies of the references cited in a previous Office Action.

In an attempt to fulfill the requirements of obviousness rejection against claim 6, the Office Action suggests that it “would have been obvious to one of ordinary skill in the art at the time of the invention was made to provide copper studs on the contact pads of Lo as taught by Joshi in order to prevent silicon die cratering.”²

The problem of “silicon cratering” is explained in the Joshi publication as follows:

“Cratering” is a defect in which a portion of a die is torn loose by an excessive amount of ultrasonic wire-bonding energy.³

Joshi further suggests that the problem is not solved satisfactorily by a “nickel bumping process” described by Strandjord et al. because “[n]ickel is ... harder than copper, and therefore the embodiments described in Strandjord et al. are more prone to bond cratering during wire bonding.”⁴

If the other references cited in the Office Action disclose wire-bonding operation, then it may be reasonable to combine them with the teaching of Joshi in

¹ U.S. Patent Publication No. 2003/0173684 A1, published Sep. 18, 2003 on an application filed Mar. 11, 2003 by Joshi et al.

² The Final Office Action, page 5, Dec. 15, 2006. (emphasis added).

³ Joshi, supra, [0004].

⁴ Id. [0008]. (emphasis added).

order to avoid silicon cratering. But none of the references, other than the Joshi reference, relates to wire-bonding. And because silicon cratering is not an issue with other references, a suggestion that there is motivation to combine with Joshi is nonsensical.

The primary reference in the Final Office Action is the Lo reference.⁵ It teaches, as stated in the Final Office Action, the use of solder to connect the wafer to the leadframe:

Lo teaches ...place a predetermined amount of solder paste on each of said first segment ends (Col 3 Ln 50-52); ... connecting said leadframe to said wafer by said metal studs and said first segment ends and reflowing said solder paste (Col 3 Ln 50-52)...⁶

The Lo reference does not teach wire-bonding, and it does not teach “a leadframe having a plurality of segment groups for each device unit ... or separating an encapsulated wafer and leadframe into individual encapsulated device” The Egawa reference⁷ is used to cure the defect in Lo. However, the Egawa reference does not teach wire-bonding either; contrarily, it teaches connecting a semiconductor device to a circuit board “through solder balls.”⁸ Therefore, silicon cratering is not a concern with Egawa.

Lastly, the Chow reference⁹ is brought in to cure the defect in Lo, which does not teach that the device unit is protected by an overcoat, windows in the overcoat, barrier metal layer in the windows. However, the Chow reference teaches a method of fabrication of solder bumps on a semiconductor wafer¹⁰; it does not teach wire-bonding and therefore silicon cratering is also not a concern.

In summary, because the Lo reference, the Egawa reference, and the Chow reference do not teach a wire-bonding operation, they cannot be concerned with excessive amount of ultrasonic energy during a wire-bonding operation that may tear

⁵ U.S. Patent Publication No. 2002/0079592 A1, published Jun. 27, 2002 on an application filed Dec. 22, 2000 by Lo et al.

⁶ The Final Office Action, *supra*, page 3.

⁷ U.S. Patent No. 6,426,554, on an application filed Mar. 6, 2000 by Egawa.

⁸ Egawa, *supra*, see, e.g., col. 3, lines 7 through 14.

⁹ U.S. Patent No. 6,413,851, on an application filed June 12, 2001 by Chow et al.

¹⁰ *Id.* see, e.g., the title.

loose a portion of a die and therefore creating a silicon crater. And because silicon cratering is not an issue with the Lo reference, the Egawa reference, and the Chow reference, it would not have been obvious to one of ordinary skill in the art, contrary to the suggestion in the Final Office Action, at the time of the invention was made to provide copper studs on the contact pads of Lo as taught by Joshi in order to prevent silicon die cratering. Therefore, applicants respectfully submit that the 103 rejection against claim 5 is improper and claim 5 must stand patentable over the references.

Claims 6 through 9 and claim 12 properly depend from claim 5. Since claim 5 is not obvious over the cited references and stands patentable, its dependent claims also must not be obvious, and therefore stand patentable over the references.

For the reason presented above, applicants respectfully submit that all claims in this case are in condition for allowance.

Respectfully submitted,

/Yingsheng Tung/

Yingsheng Tung
Attorney for Applicants
Reg. No. 52,305

Texas Instruments Incorporated
P. O. Box 655474 MS 3999
Dallas, TX 75265
(972)917-5355